## REMARKS

Claims 1-48 were pending. Claim 37 has been amended editorially for clarity. Claims 49-55 have been added. Claims 1-55 are pending.

1. Rejection under 35 U.S.C. § 102(b) based on Mine et al.:

Claims 1-3, 7-9, 11, 12, 19, 31, 32, 43, 47, and 48 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Japanese patent document JP 09-054828 in the name of Mine et al. Applicant respectfully traverses this rejection.

Claim 1 recites an image processing apparatus that includes "gradient calculation means for calculating at least the direction of the level gradient of each of a plurality of processing units in a given image data including a plurality of pixels, the pixels respectively having level data," "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means."

In the present invention, line segment image data is obtained having a given length and a direction corresponding to the direction of each level gradient. As a result, even if the contour of an image is not necessarily clear, a distinct line segment can be obtained. Consequently, even a low-contrast image or an image including noise can be subjected to stable image processing.

The reference to Mine et al. discloses an apparatus for calculating the degree of similarity between an input image and a model image. The apparatus digitizes the images, and computes the pixel-by-pixel difference between the density gradient direction for the input image and the density gradient direction for the model image. Concentration gradient intensities are computed for the model image, and these values are used in a

weighted evaluation of the density gradient differences in evaluating the similarity between the input image and the model image. The apparatus disclosed by the Mine et al. reference has a direction calculation section 16 that computes the density gradient direction of the input image. Referring to paragraph 59 of the Mine et al. reference machine translation, "...in the direction calculation section 16 of a concentration gradient, the picture incorporated by the image memory 3 is changed in the direction of an input concentration gradient [(b) of drawing 12], and is memorized by memory 9." The direction of an input concentration gradient memorized by memory 9 is I theta (Iθ) (x, y). Thus, the direction of an input concentration gradient is angle data. Mine et al. does not teach or suggest an image processing apparatus that includes "line segment formation means for producing *line segment image data* representing a line segment for each of the plurality of processing units, each line segment having a *given length.*" On the contrary, the gradient level *direction* for each pixel in the input image is sufficient for the similarity comparison performed by the apparatus disclosed by the Mine et al. reference.

The gradient level direction of the input image is represented in Fig. 12b of the reference to Mine et al., referred to by the Examiner. Although Fig. 12b of the Mine et al. reference may appear like an image represented by image data, Fig. 12b and its associated text merely teach angles (the direction of the input concentration gradient) and do not teach or suggest line *segments* or line segments having a *given length.* Given that the Mine et al. reference does not disclose or suggest "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a *given length,*" the reference also fails to disclose "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claim 1, and its dependent claims 2, 3, 7-9, 11, 12, 19, 43, and 47 are not anticipated by the reference to Mine et al. New claims 49 and 50 depend from claim 1, and also are submitted as patentable over the cited reference to Mine et al.

Claim 8 is further distinguished from the cited reference to Mine et al. Claim 8 depends from claim 1, and recites that the "gradient calculation means calculates the magnitude of the level gradient in addition to the direction of the level gradient," and the "line segment formation means produces line segment image data including a level value, the level value corresponding to the magnitude of the level gradient which is calculated by said gradient calculation means." As noted above, the reference to Mine et al. does not disclose a line segment formation means. Further, the Mine et al. reference does not disclose a line segment formation means that "produces line segment image data including a level value, the level value corresponding to the magnitude of the level gradient which is calculated by said gradient calculation means." The Mine et al. reference discloses that a gradient level threshold is used in processing determinations, but does not disclose an apparatus that produces "line segment image data including a level value."

Claim 31 recites an image processing method that includes "calculating at least the direction of the level gradient of each of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data," "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient," and "storing the produced line segment image data in storage means."

The reference to Mine et al. discloses analyzing the degree of similarity between an input image and a model image. The method computes the pixel-by-pixel difference between the density gradient direction for the input image and the density gradient direction for the model image. The similarity between the input image and the model image is based on a weighted evaluation of the density gradient differences. The Mine et al. reference discloses calculating a direction of density gradient, but not "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level

gradient," and "storing the produced line segment image data in storage means." Claim 31 is not anticipated by the reference to Mine et al. New claims 51 and 52 depend from claim 31, and also are submitted as patentable over the Mine et al. reference.

Claim 32 recites a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient of each of a plurality of processing units in given image data including a plurality of pixels, the pixels respectively having level data," "produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient," and "store the produced line segment image data in storage means."

The Mine et al. reference discloses a program for comparing an input image to a model image. The program causes a computer to calculate input gradient directions, but does not "produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each pixel having a non-zero level gradient," and "store the produced line segment image data in storage means." Claim 32 is not anticipated by the reference to Mine et al.

Claim 48 recites an image processing apparatus that includes "a gradient calculator which calculates at least the direction of the level gradient of a processing unit in a given image data including a plurality of pixels, the pixels respectively having level data," "a line segment former which produces line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means," and "line segment image storage which stores the line segment image data produced by said line segment formation means."

The reference to Mine et al. discloses an image processing apparatus that produces a weighted comparison between the density gradient direction of an input image and the density gradient direction of a model image. The apparatus disclosed by the Mine et al. reference includes a direction calculation section 16 that computes the density gradient direction of the input image, but does not have "a line segment former which produces line segment image data representing a line segment having a given length and a direction corresponding to the direction of the level gradient which is calculated by said gradient calculation means," and "line segment image storage which stores the line segment image data produced by said line segment formation means." Claim 48 is not anticipated by the reference to Mine et al.

2. Rejection under 35 U.S.C. § 103(a) based on Mine et al.:

Claims 20-22, 28-30, 33, 34, and 44 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mine et al. (JP 09-054828). Applicant respectfully traverses this rejection.

Claims 20-22 depend from claim 1, which is not anticipated or rendered obvious by the Mine et al. reference, as noted above in connection with claim 1. Claims 20 and 22 are submitted as patentable over the cited reference to Mine et al.

Claim 20 is further distinguished from the cited reference to Mine et al. Claim 20 recites the image processing apparatus of claim 1, further comprising "a display device for displaying a line segment image represented by the line segment image data produced by said line segment formation means or the line segment image data stored in said line segment image storage means." The Examiner admits that the reference to Mine et al. does not expressly disclose displaying line segment images. Further, Mine et al. does not disclose producing line segments. As noted above in connection with claim 1, the Mine et al. reference does not disclose a "line segment formation means" or a "line segment image storage means for storing the line segment image data produced by said line segment formation means" as recited in claim 1, and consequently does not disclose "a display

device for displaying a line segment image represented by the line segment image data produced by said line segment formation means or the line segment image data stored in said line segment image storage means."

The Examiner's conclusory statements notwithstanding, it would not have been obvious to modify the Mine et al. reference to include such a display device, since the reference to Mine et al. does not produce line segments. The Mine et al. reference is directed to calculating a degree of similarity between images, which does not require the production of line segment image data. Thus, production of line segments is not suggested by the Mine et al. disclosure. The motivation to modify the disclosure of the Mine et al. reference as suggested by the Examiner comes only from applicant's disclosure, as part of an improper hindsight reconstruction of the invention recited in claim 20. Claims 20-22 are submitted as patentable over the cited reference to Mine et al.

Claim 28 recites an image processing apparatus having "image processing means for calculating at least the direction of the level gradient of each of a plurality of processing units in given image data, and producing line segment data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "display means for displaying the line segment images represented by the line segment image data produced by said image processing means."

As noted above in connection with claim 20, the Examiner admits that the Mine et al. reference does not expressly disclose displaying line segment images. Further, the Mine et al. reference does not disclose a "line segment formation means" or a "line segment image storage means for storing the line segment image data produced by said line segment formation means" as recited in claim 1, and consequently does not disclose "a display device for displaying a line segment image represented by the line segment image data produced by said line segment formation means or the line segment image data stored in said line segment image storage means." The Examiner's unsupported conclusion that

it would have been obvious to modify the disclosure of the Mine et al. reference to include such a display device is not sufficient to establish a *prima facie* obviousness rejection. The reference to Mine et al. does not teach or suggest production of line segments, which are not necessary to determining the similarity between an input image and a model image. The motivation to modify the teachings of the Mine et al. reference as suggested by the Examiner, in a hindsight effort to reconstruct the invention as recited in claim 28, comes only from applicant's disclosure. Claim 28, and its dependent claims 29, 30, and 44 are submitted as patentable over the cited reference to Mine et al.

Claim 33 recites an image processing method that includes "calculating at least the direction of the level gradient of each of a plurality of processing units in given image data," "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each image data having a non-zero level gradient," and "displaying line segment images represented by the produced line segment image data on a display device."

As noted above, the method disclosed in the Mine et al. reference does not produce "line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length," and the Examiner admits that the Mine et al. reference does not expressly disclose displaying line segment images. The Examiner concludes that it would be obvious to modify the teachings of the Mine et al. reference to include such a display device, but unsupported conclusions are not sufficient to establish a *prima facie* obviousness rejection. The reference to Mine et al. does not teach or suggest production of line segments, which are not necessary to determining the similarity between an input image and a model image. Thus, the motivation to modify Mine et al. as suggested by the Examiner is not found in the prior art, as would be required to establish a *prima facie* obviousness rejection. Claim 33 is submitted as patentable over the cited reference to Mine et al.

Claim 34 recites a medium storing a program for controlling a computer so as to "calculate at least the direction of the level gradient for each of a plurality of processing units in given image data, and produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length and a direction corresponding to the calculated direction of the level gradient for each processing unit having a non-zero level gradient," and to "display line segment images represented by the produced line segment image data on a display device."

Arguments analogous to those presented above for claim 33 are applicable to claim 34. The Mine et al. reference does not disclose a program for controlling a computer so as to "produce line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length," and the motivation to modify the disclosure of the Mine et al. reference comes only from applicant's disclosure. Claim 34 is submitted as patentable over the cited reference to Mine et al.

3. Rejection under 35 U.S.C. § 103(a) based on Mine et al. and Huang et al.:

Claims 16, 23, 26, 27, 35-41, 45, and 46 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mine et al. (JP 09-054828) in view of U.S. Pat. No. 5,903,660 to Huang et al. Applicant respectfully traverses this rejection.

Claims 16, 23, 26, and 27 depend from claim 1, which is submitted as patentable over the cited reference to Mine et al. The Huang et al. reference does not cure the deficiencies of the reference to Mine et al. The reference to Huang et al. discloses a system for removing a background from an image. Background caused by circular collimators is removed by using "gradient angle information and the coordination of pixels selected by sampling and filtering to form straight line equations" for each pixel, and finding the point of intersection of normals to the lines, which should be the center of a circular collimator. The radius of the circle is calculated, and the background outside of the circular collimator is removed. The Huang et al. reference does not provide the

teachings missing from the Mine et al. reference of a processing apparatus including "line segment formation means for producing line segment image data representing a line *segment* for each of the plurality of processing units, each line segment having a *predetermined length*," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claims 16, 23, 26, and 27 are submitted as patentable over the cited references to Mine et al. and Huang et al.

Claim 35 recites an image processing apparatus including "means for extracting a plurality of edges whose level gradients are not less than a threshold value in given image data," "means for setting, for each of the edges, a line segment extending a *predetermined length* in a direction corresponding to the direction of the extracted edge," and "means for detecting the presence or absence of a point of intersection of a plurality of line segments and the position thereof."

The reference to Mine et al. discloses a system for comparing the similarity of an input image and a model image, as discussed above. The Examiner refers in section 6, page 5 of the Office Action to paragraphs 52-54 of the machine translation of the Mine et al. reference, which discuss determination of the direction of a concentration gradient and concentration gradient intensity in the model image. Fig. 3b, discussed in paragraph 52 of the reference to Mine et al., represents the concentration gradient *intensity* of the model image, not *line segments*. The Examiner asserts that paragraph 27 of the machine translation of the Mine et al. reference discloses producing a line segment extending a predetermined length in a direction corresponding to the direction of an extracted edge. Applicant respectfully disagrees. Paragraph 27 of the Mine et al. reference machine translation appears to discuss apparatus for calculating concentration gradient and concentration gradient intensity, and for storing a concentration gradient in each pixel of two or more model images. Line segments are not discussed. The reference to Mine et al. does not disclose "means for setting, for each of the edges, a line segment extending a *predetermined length* in a direction corresponding to the direction of the extracted edge."

The reference to Huang et al. does not cure the deficiencies of the Mine et al. reference. The Huang et al. reference discloses a system for removing a background from an image in which straight line equations are computed for each *pixel*, and the point of intersection of normals to the lines are considered to be the center of a circular collimator. The radius of the circle is calculated, and the background outside of the circular collimator is removed. The reference to Huang et al. does not teach or suggest an image processing apparatus including "means for setting, for each of the *edges*, a line segment *extending a predetermined length* in a direction corresponding to the direction of the extracted edge." Claim 35, and its dependent claims 36 and 45, are submitted as patentable over the cited references to Mine et al. and Huang et al.

Claim 37 recites an inspection apparatus including "image input means for inputting image data representing an inspection object," "means for calculating at least the direction of the level gradient of each of a plurality of processing units in said input image data, and producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a specified length and a direction corresponding to the calculated direction of the level gradient," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

The reference to Mine et al. discloses a system for determining the similarities between an input image and a model image. The Mine et al. reference does not disclose an inspection apparatus having means for "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data."

The reference to Huang et al. does not cure the deficiencies of the Mine et al. reference. The Huang et al. reference discloses a system for removing a background from

an image in which straight line equations are computed for each pixel. The point of intersection of normals to the lines are considered to be the center of a circular collimator. The radius of the circle is calculated, and the background outside of the circular collimator is removed. Huang et al. does not teach or suggest an image processing apparatus including means for "producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a predetermined length," and "means for detecting the presence or absence of a portion where the line segments are concentrated or are overlapped with one another and the position thereof on the basis of the produced line segment image data." Claim 37, and its dependent claims 38-42 and 46 are submitted as patentable over the cited references to Mine et al. and Huang et al. New claims 54 and 55 depend from claim 37, and are also submitted as patentable over the cited references to Mine et al. and Huang et al.

4. Rejection under 35 U.S.C. § 103(a) based on Mine et al. and Lin et al.:

Claims 4, 5, and 10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mine et al. (JP 09-054828) in view of U.S. Pat. No. 6,292,582 to Lin et al. Applicant respectfully traverses this rejection.

Claims 4, 5, and 10 depend from claim 1, which is submitted as patentable over the cited reference to Mine et al. The reference to Lin et al. does not cure the deficiencies of the Mine et al. reference. The reference to Lin et al. has been cited as providing a means for setting a processing region, producing image data at gray level, and adding new line segment data to line segment data already stored in each pixel, which the Examiner finds to be missing from the reference to Mine et al. The Lin et al. reference discloses a system for identifying defects that relies on decomposing an image of a manufacture object into a primitive-based representation, and comparing the representation to a primitive-based reference image. Lin et al. does not provide the teachings missing from the reference to Mine et al. of "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given and a direction corresponding to the direction of each level gradient which

is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claims 4, 5, and 10 are submitted as patentable over the cited references to Mine et al. and Lin et al.

Claim 10 is further distinguished from the proposed combination of the references to Mine et al. and Lin et al. Claim 10 recites an image processing apparatus according to claim 1, wherein the "line segment image storage means adds new line segment image data to line segment image data already stored at each of the pixels, and stores the result of the addition." Thus, each pixel accumulates line segment image data. In contrast, the Lin et al. reference discloses a process of generating an image by progressively appending a new line to the end of an old line. The reference to Lin et al. does not teach or suggest an apparatus that "adds new line segment image data to line segment image data already stored at each of the pixels."

5. Rejection under 35 U.S.C. § 103(a) based on Mine et al. and Tachibana:

Claims 13-15 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mine et al. (JP 09-054828) in view of U.S. Pat. No. 5,898,440 to Tachibana. Applicant respectfully traverses this rejection.

Claims 13-15 depend from claim 1, which is submitted as patentable over the cited reference to Mine et al. The Tachibana reference does not cure the deficiencies of the Mine et al. reference. The Tachibana reference discloses a system for carrying out antialiasing on lines that are close to or cross each other. A digital differential analyzer generates line data according to antialiasing conditions and draws the line between start and end points in a bitmap. The reference to Tachibana does not teach or suggest "line segment formation means for producing line segment image data representing a line segment *for each of the plurality of processing units*, each line segment having a given and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line

segment image data produced by said line segment formation means." Claims 13-15 are submitted as patentable over the cited references to Mine et al. and Tachibana.

6. Rejection under 35 U.S.C. § 103(a) based on Mine et al. and King et al.:

Claims 17, 18, 24, and 25 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mine et al. (JP 09-054828) in view of U.S. Pat. No. 5,926,557 to King et al. Applicant respectfully traverses this rejection.

Claims 17, 18, 24, and 25 depend from claim 1, which is submitted as patentable over the cited reference to Mine et al. The reference to King et al. does not cure the deficiencies of the Mine et al. reference. The reference to King et al. has been cited as providing means for detecting the position of a pixel having a maximum gradient. The King et al. reference does not provide the teachings missing from the reference to Mine et al. of "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claims 7, 18, 24, and 25 are submitted as patentable over the cited references to Mine et al. and King et al.

Claim 17 is further distinguished from the proposed combination of the Mine et al. reference with the reference to King et al. Claim 17 recites an image processing apparatus according to claim 1, further comprising "means for detecting the position of the pixel having the maximum of the levels of the line segment image data stored in said line segment image storing means." The King et al. reference discloses a system for locating a "point of maximum gradient (i.e. the steepest or greatest change from darkest to brightest pixels)." (Col. 11, lines 4-6.) The reference to King et al. does not teach or suggest a system that determines "the maximum of the levels of the line segment image data."

7. Rejection under 35 U.S.C. § 103(a) based on Mine et al. and Williams et al.:

Claim 6 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Mine et al. (JP 09-054828) in view of U.S. Pat. No. 6,427,030 to Williams et al. Applicant respectfully traverses this rejection.

Claim 6 depends from claim 1, which is submitted as patentable over the cited reference to Mine et al. The Williams et al. reference does not cure the deficiencies of the reference to Mine et al. The reference to Williams et al. has been cited by the Examiner as providing conversion of gray level pixel data image data to binary level pixel image data, found to be missing from the Mine et al. reference. The Williams et al. reference discloses a system for diffusing to adjacent pixels an error value generated for the pixel by threshold processing. The reference to Williams et al. does not provide the teachings missing from the reference to Mine et al. of "line segment formation means for producing line segment image data representing a line segment for each of the plurality of processing units, each line segment having a given and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claim 6 is submitted as patentable over the cited references to Mine et al. and Williams et al.

8. Rejection under 35 U.S.C. § 103(a) based on Mine et al., Huang et al., and Tachibana:

Claim 42 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Mine et al. (JP 09-054828) in view of Huang et al., further in view of Tachibana. Applicant respectfully traverses this rejection.

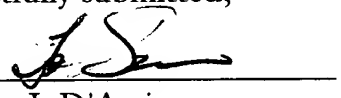
Claim 42 depends from independent claim 37, which is submitted as allowable over the cited references to Mine et al. and Huang et al. The Tachibana reference does not cure the deficiencies of the references to Mine et al. and Huang et al. The reference to Tachibana discloses an antialiasing system that can distinguish lines close to or crossing each other. A digital differential analyzer generates line data according to antialiasing

conditions and draws the line between start and end points in a bitmap. Tachibana does not provide the teachings missing from the Mine et al. and Huang et al. references of "line segment formation means for producing line segment image data representing a line segment *for each of the plurality of processing units*, each line segment having a specified length and a direction corresponding to the direction of each level gradient which is calculated by said gradient calculation means," and "line segment image storage means for storing the line segment image data produced by said line segment formation means." Claim 42 is submitted as patentable over the cited references to Mine et al., Huang et al., and Tachibana.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Dated: May 18, 2004

Respectfully submitted,

By 

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